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## C1Po1E-06: Upgraded shield refrigerator for Jefferson Lab's Cryogenic Test Facility

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The Cryogenic Test Facility (CTF) at Jefferson Lab provides cryogenics to support production and testing of accelerator cryomodules. Within the CTF, a standalone shield refrigerator produces nominally 35 K helium to cool heat shields in the cryomodules and cryogenic distribution system. It consists of four heat exchangers packaged into a cold box and a separate reciprocating expander pod. After 35 years of service, the shield refrigerator was unable to keep up with modern operations due to undersized heat exchangers, process and vacuum leaks, and expander wear and tear. A replacement shield refrigerator cold box has been designed and constructed by Jefferson Lab. The new heat exchangers were sized to meet thermal and hydraulic performance requirements during all operating modes, including a new bypass mode which allows shield flow to be supplied at 80 K while the expander is offline for maintenance. The expander pod itself was also refurbished and upgraded by a third-party contractor. This paper will discuss the design of the upgraded shield refrigerator and its performance during commissioning. Helium and nitrogen usage rates and expander rotational speeds under all operating modes have been reduced, and mean time between maintenance for the reciprocating expander has increased. The upgraded system improves CTF resource consumption and shield flow availability, benefitting cryomodule production and testing throughput.

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